■ SLEEP BRUXISM

Effects of Sleep Bruxism On Periodontal Sensation and Tooth Displacement in the Molar Region

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ABSTRACT: The purpose of this study was to investigate the effects of sleep bruxism on periodontal sensation and tooth displacement in the molar region. Twenty-eight (28) subjects lacking objective or subjective abnormalities in stomatognathic function were divided into two groups representing bruxers (n=14) and controls (n=14). Sleep bruxism was confirmed based on the nocturnal electromyography activity of the masseter muscle. Periodontal sensation was assessed based on interocclusal tactile threshold (ITT), which refers to the minimal thickness that can be detected between the occlusal surfaces of the teeth. ITT was measured in the first molar region. Displacement of teeth during clenching was measured using a two-dimensional tooth displacement transducer. Statistical analysis of the differences in ITT and tooth displacement between the bruxers and controls was performed by Mann Whitney U-test ($p<0.05$). Mean ITT for bruxers was significantly lower than that for controls ($p<0.01$). The mean displacement of both the maxillary and mandibular first molar for the bruxers was significantly larger than that for the controls ($p<0.05$). The results of this study suggest that sleep bruxism affects both periodontal sensation and tooth displacement.

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The periodontium has sensory receptors[1-5] and serves a physical function when a tooth is displaced by occlusal force.[6,7] Sleep bruxism is a harmful oral habit in which excessive amounts of occlusal force are applied to the teeth.[8,9] Since the periodontium in sleep bruxism patients suffers from excessive occlusal force for long periods of time during sleep, the function of the periodontium in such patients may differ from that in patients without sleep bruxism. To understand effects of sleep bruxism on patients' periodontal sensation is clinically important, since occlusal evaluations and adjustments are the most frequently performed clinical procedure, especially when newly fabricated prostheses are inserted.

Mantyvaara, et al.[10] investigated the effects of sleep bruxism on periodontal sensation and found that the tactile detection threshold of maxillary central incisors did not differ significantly between individuals with sleep bruxism and those without. Unfortunately, their sleep bruxism evaluation was only based on clinical examination without objective measurement of sleep bruxism. It is known that clinical signs and symptoms believed to be suggestive of sleep bruxism are not always accurate indicators of sleep bruxism.[11] Previously, we studied seven

subjects with sleep bruxism and seven controls, whose bruxism status was confirmed by objective nightly masseter EMG measurement.[12] Furthermore, since the force during sleep bruxism is mainly on the molars, the current study investigated periodontal sensation of the molars. Sensation of the molars in subjects with sleep bruxism was found to be higher than that in subjects without sleep bruxism. The limitations of this study was the small number of subjects and the lack of information on tooth mobility. In the literature, although sleep bruxism is not regarded as a primary causal factor in periodontal diseases,[13] it is related to tooth mobility. This association, however important, has never been fully understood. Periodontal sensation can be affected by tooth mobility. In order to understand the effects of sleep bruxism on periodontal sensation, mobility of the corresponding teeth should also be investigated.

Based on this reasoning, the present study is an expansion of a previous study investigating the effects of sleep bruxism on periodontal sensation using interocclusal tactile threshold (ITT), which refers to the detectable minimal thickness.[12] The aims of the current study were to investigate the effects of sleep bruxism on periodontal sensation in the molar region and on mobility of the corresponding teeth.

Materials and Methods

Subjects

Twenty-eight (28) dental school faculty members and students without objective or subjective abnormalities in stomatognathic function (age range: 21 to 30 years; average: 26.3 years) participated in this study. All subjects had a stable maximum intercuspal position and no crowns or prostheses covering the occlusal surfaces of the left first molar. Based on the clinical criteria suggested by Dube, et al.,[14] the participants were divided into two groups; 14 bruxers and 14 controls.

Sleep bruxism status was confirmed by measurement of nocturnal electromyography (EMG) activity of the masseter muscle using a portable surface EMG machine (EMG-021/025, KTR-2302B; Harada Electronic Industry Ltd., Sapporo, Japan) **Figure 1**. Subjects were instructed in the use of this device until they were able to perform EMG measurements correctly. They then used the device at home to perform EMG recordings from the right and the left masseter muscles for one night. Sleep bruxism status of each subject was confirmed by the acquired EMG data. All 14 bruxers satisfied the diagnostic standards proposed by Lavigne, et al.,[15] while the 14 controls did not (**Table 1**).

The protocol of this study was approved by the Ethics Committee of Showa University School of Dentistry and an informed consent was obtained from all subjects.

Measurement of ITT

For ITT measurement, 1.5x1.5 mm pieces of aluminum foil (Nippon Foil Mfg Co. Ltd., Tokyo, Japan) with thicknesses of 5, 10, 15, 20, 25, 30, 35, 40, 45, and 50 µm were used. This range of foil thickness was determined according to previous studies in which thicknesses ranged from 10 to 35 µm,[16] from 8 to 32 µm,[17] and from 10 to 50 µm.[18] Each subject was asked to sit in a dental chair, and after the occlusal contact area on the mesial buccal cusp of the mandibular left first molar was confirmed using articulating paper (G.C. Corp., Tokyo, Japan), a piece of aluminum foil was placed on this area. The subject was asked to occlude five times and to indicate whether or not he/she was able to detect the presence of the piece of foil between the occlusal surfaces of the teeth. On each attempt, foil was incrementally replaced with a piece having a different thickness. The minimal thickness that could be detected was considered the ITT. The pilot study suggested that there were no significant differences in ITT between the morning and afternoon or between the left and right sides for both the bruxers and controls. Therefore, ITT was measured on the left side on three separate days and three ITT data were averaged for each subject.

Measurement of Tooth Displacement

Among 28 subjects, 12 (six bruxers and six controls) were selected randomly for measurement of tooth displacement. They were asked to perform three maximum voluntary clenching efforts in their intercuspal jaw position and clenching-induced tooth displacement was mea-

Figure 1
Portable surface electromyography machine.

Table 1
Confirmation of Sleep Bruxism Based On Diagnostic Standards Proposed by Lavigne, et al.[14]*

Variables	Cut-off	Bruxers	Controls
Number of bruxism episodes per night	>30	0	0
Number of bruxism episodes per hour	>4	3	0
Number of bruxism bursts per episodes	>6	11	0
Number of bruxisms per hour	>25	0	0

* Bruxism bursts were defined as EMG potentials with an amplitude of at least 20% of maximum voluntary contractions. Bruxism episodes were phasic, tonic or mixed (both phasic and tonic) episodes. Phasic episodes corresponded to at least three EMG bursts of 0.25 to 2.0 seconds in duration, separated by two interburst intervals. Tonic episodes corresponded to EMG bursts lasting more than 2.0 seconds. Diagnosis of sleep bruxism was made if any one of the four criteria was satisfied.

sured using a 2-dimensional transducer Type-K (**Figure 2**) fixed to the labial surface of the anterior teeth using an aluminum clutch. The mesio-buccal angle of the maxillary and mandibular left first molars were selected as measurement points, and movement of these two points were measured 2-dimensionally in the bucco-lingual and colono-apical directions (**Figure 3**). Analog data obtained from this transducer were converted to digital data using Maclab (A.D. Instruments, Electronic Industry Ltd., Lexington, Australia) and were stored in a personal computer for off-line analysis. Two 500-ms periods, which corresponded to before and during clenching, were selected and averaged for each measurement point. Two-dimensional components of the displacement and length of displacement were obtained for each effort. Regarding these displacement data, mean values of three efforts were calculated for each subject.

Statistical Analysis

Statistical analysis of differences in ITT and length of molar displacement between the bruxers and controls was performed using the Mann-Whitney U-test. Statistical significance was set at the 5% level.

Figure 2
Two-dimensional tooth displacement transducer Type-K.

Results

Interocclusal Tactile Threshold

Mean ITT for bruxers was significantly lower than that for controls (**Table 2**).

Tooth Displacement

The clenching-induced displacement of the maxillary first molar was in the palato-apical direction, while that of the mandibular first molar was in the lingual direction. This tendency was consistent, irrespective of sleep bruxism status.

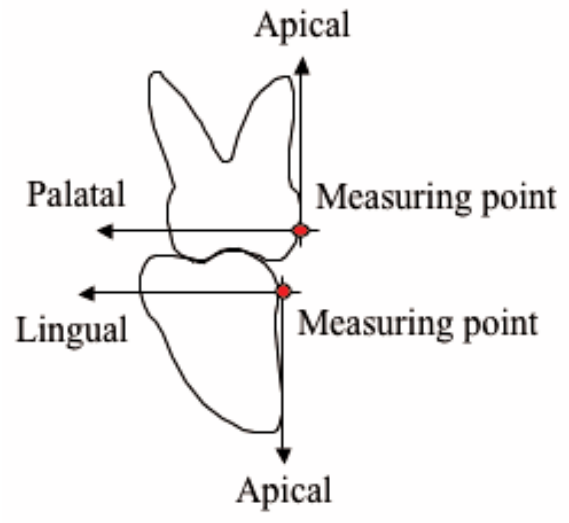

Figure 3
Measuring point and measuring direction.

Table 2
Mann-Whitney U-Test Results for ITT Data Between Subjects

	Mean	SD	Mean rank	N	U	Z	p
Bruxers	18.4	4.7	7.5	14	195.5	-4.46	<0.001
Controls	32.9	5.3	21.5	14			

Mean displacement of both maxillary and mandibular first molars for the bruxers was significantly larger than that for the controls (**Table 3**).

Discussion

The results of this study support our previous study. ITT in subjects with sleep bruxism was shown to differ from those without sleep bruxism, which suggests that the threshold for periodontal sensation is lower in bruxers. The present method for testing ITT in the molar region produced similar values as reported by other authors.[16-20] The effects of sleep bruxism on periodontal sensation were previously reported in terms of tactile detection threshold (TDT) of the maxillary central incisors by Mantyvaara, et al.[10] In contrast to the results of our study, they did not find significant effects of sleep bruxism on TDT. The receptors that sense external force applied to teeth are the periodontal mechanoreceptors and intradental mechanoreceptors.[4] Either one or both types react to mechanical stimulation of the periodontium, but the mode of response to these receptors varies depending on the type of stimulation. While periodontal mechanoreceptors respond to stimulation with a wide range of stimulation velocities, intradental mechanoreceptors respond to fast stimulation, such as tapping.[4] Therefore ITT may involve not only periodontal mechanoreceptors, but also intradental mechanoreceptors, while TDT may involve only periodontal mechanoreceptors. In addition, TDT is reported to vary depending on loading method, loading direction, and tooth type.[2,21] These possibilities may account for the differences between our results and those reported by Mantyvaara, et al.[10]

Regarding tooth displacement, the maxillary molar was displaced buccaly, while the mandibular molar was displaced lingually. These trends were independent of sleep bruxism status and generally agree with previously reported data.[6,7] However, the amount of tooth displacement in the bruxers was significantly higher than that in the controls, thus suggesting that sleep bruxism increases the amount of clenching-induced tooth displacement. In the literature, sleep bruxism is reportedly correlated with dental wear, but not with periodontal disease.[13] As the current study subjects had healthy periodontal structure, the increased mobility in bruxers should be regarded as within the normal range. However, it is know that sleep bruxism may cause jiggling force to the teeth, resulting in a temporal increase in the tooth mobility. It has also been

Table 3
Mann-Whitney U-Test Results for Tooth Displacment Between Subjects

		Mean	SD	Mean rank	N	U	Z	p
Maxillary First molar	Bruxers	153.6	26.4	8.8	6	4	2.16	<0.05
	Controls	103.0	32.3	4.2	6			
Mandibular First molar	Bruxers	86.6	5.9	9.5	6	0	2.80	<0.01
	Controls	53.0	6.1	3.5	6			

shown that bruxers used significantly higher bite forces to hold the submaximal loads when compared to controls,[23] which might also cause increased tooth mobility.

One of the limitations of this study was usage of dental school faculty members and students as the study subjects, which might have made our study results less generalizable. A merit of these subjects was that their dental status is relatively and consistently excellent, which is an important factor that has potential to influence tooth mobility. Conversely, we are not aware of any evidence that sleep bruxism or ITT status in dental faculty and students are different from other populations. This should be answered by future studies.

The observed mean ITT in the bruxers was 18.4±4.7 µm. Clinically, it is difficult to adjust occlusal contact to an accuracy of 20 µm or less using articulating paper.[24] In addition, the larger tooth displacement observed in bruxers makes clinical examination of occlusal contact using articulating paper even more difficult. These study results suggest that periodontium in individuals with sleep bruxism reacts differently to occlusal contact than those without sleep bruxism when adjusting and correcting occlusal contact for fixed prostheses is considered, which is regarded as new and important information essential to improve clinical procedures.

Conclusion

The results of this study suggest that the presence of sleep bruxism affects both periodontal sensation and tooth displacement.

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